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Research Article

STUDY OF TEXTURE AND COLOR OF THE SPONGE CAKE PRODUCED USING THE DIFFERENT LEVELS OF SOY FLOUR

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ABSTRACT
In this study, adding different levels of soy bean in the amounts of %5, %10 and %15 to sponge cake, physical tests such as texture and color analysis of the sponge cake samples were carried out in the laboratory of the Faculty of Agriculture, Islamic Azad University, Sanandaj Branch in Iran. The aim of the study was to enrich the product with soy flour particularly in terms of Lysine and Threonine Amino Acids and also examining its color and texture improvement. To make the sponge cake, investigative study (Iran National Standard, 2553) was carried out. To analyze the texture, the research resource (Bourne, 2002) and to analyze the color the survey (Afshari and Farahnaky, 2011) were used. In this study, the texture analysis was repeated 5 times and the color analysis was repeated 3 times. The resulted data were analyzed statistically by using the SAS 9.1.3 software and the Duncan test at the probability level $p \leq 0.05$. Based on the texture analysis, the parameters such as maximum strength, slope, and cohesiveness were significantly different at the probability level $p \leq 0.05$ but the difference in terms of the springiness was not significant. Based on the color analysis, there was a significant difference at the probability level $p \leq 0.05$ among the L, a, b values. As the level of soy flour increased, the hardness and darkness increased and the springiness and the cohesiveness decreased due to the increase in the protein content.

Keywords: *Sponge Cake, Soy Flour, Enriched, Texture, Color*

INTRODUCTOIN
Today, costumers are more willing to consume food enriched with different vitamins, minerals and proteins (Mirshahi**,** 2010). In recent years, due to the nutritional value of legumes and appropriate performance characteristics with low price and high diversity play an important role as a source of protein (Khalil & Sarkadi, 1991; El Nasri & El Tinay, 2007).
Soybean and its derivatives including soy flour are considered as one of the food with the highest amount of protein which are used in preparing different meals and snacks. Therefore, full-fat soy flour or defatted soy flour particularly replace wheat flour in different meals or snacks and since it is not very expensive, it is used by poor people in the deprived areas.
Wheat flour lacks some of the essential amino acids such as Lysine and Threonine while soy flour is rich in these amino acids. Mixing the two flours (soy flour and wheat flour) moderates the amount of the received amino acids.
Also Lipoxygenase enzyme in the soy beans makes it whiter and brighter by the oxidation process of its pigment, improves its color and makes it more customer friendly. Since soy flour is rich in proteins, it can be added to the wheat flour as a supplementary protein.
Soy bean is considered as the main constituent in the baby food and products used in losing weights and diets. Enzymes found in soy flour improve the texture and the storage properties of wheat flour in bread, giving the bread a nut flavor **(**Mirshahi**,** 2010**).**
It should be pointed out that the daily consumption of soybean prevents cancer, (because of its anti-cancer property), improves the bone density and reduces the amount of cholesterol and prevents diabetes (Sirtori & Lovati, 2001; Adebowale *et al.,* 2005).
The present study has a survey on using soy flour as a protein resource to enrich the dietary formulations of cakes. In addition, the physical features of the prepared cakes including their histological and the colorimetric features were tested and studied experimentally.

MATERIALS AND METHODS

Materials

Oil, sugar, wheat flour, baking powder, vanilla, and milk have been used as ingredients to make the cake.

Methods

How to Make the Cake: A specified amount of the ingredients including oil, wheat flour (as the control sample), soy flour (at the levels of 5%, 10%, and 15%), sugar, milk, baking powder, vanilla were mixed completely and carefully by using a blender to mix the ingredients and have a smooth dough. In addition, a sample was prepared as the control sample and three samples were prepared using5 %, 10%, 15% levels of soy flour as the experimental sample. The samples were poured in specified molds and were baked in the oven at 180 ° for 20 minutes.

Measurement Methods

Texture Analysis

Compression test was carried out to evaluate the texture of different samples of the sponge cake with and without soy flour substitution. After cutting into small cubes, the cake samples were compressed using a 75 cm Aluminum Probe in the Texture Analyzer. The probe movement speed was 5mm/s and 0.25 mm/s before the compression and during the measurement respectively. After inferring the related graphs, the maximum force, slope, springiness, and cohesiveness parameters were calculated (Bourne, 2002).

Color Evaluation

A digital camera was used to evaluate the color of different treated samples. After placing on white plates, the samples were placed into photography box with white walls (50×50×60) in which there was a low-energy fluorescent lamp with white light (40W, 220V, Cixing). The pictures were taken using a digital camera at a distance of 30 cm inside the box with vertical position with respect to the position of the samples. The obtained images were transferred to the Photoshop Software CSS and their lightness (L-value), redness-greenness (A-value) and blueness-yellowness (B-value) were calculated. The L- value shows the lightness ranging 0 -100. The A-value also fluctuates 127-128, in which negative numbers represent greenness and positive numbers represent redness. The B-value also fluctuates 127 - 128 so that negative numbers indicate blueness and positive numbers indicate yellowness (Afshari *et al.*, 2011).

RESULTS AND DISCUSSION

Results

The Texture Analysis

The compression test was carried out to analyze the texture properties of the sponge cakes enriched with soy flour. The results are summarized in table 1. Different parameters including maximum strength, slope, cohesiveness and springiness were calculated for both the samples enriched with soy flour and the control samples using the compression test.

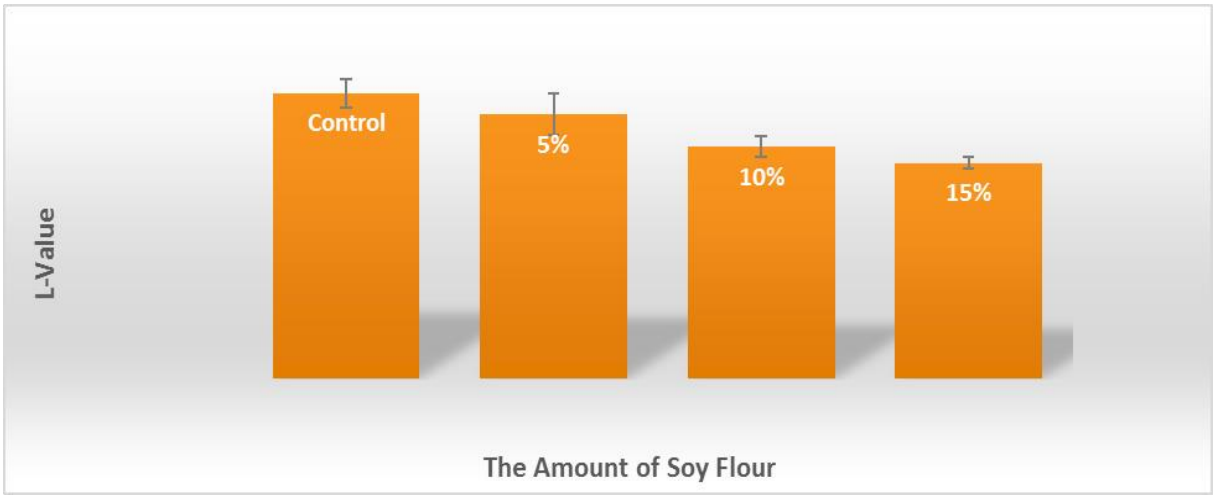
According to table 1, as the amount of soy flour increases, the maximum strength increases too, so the minimum strength was observed in the control samples and the strength increased in the enriched samples.

The maximum strength was observed in the sample cakes which were enriched with %15 soy flour. As the related data regarding determining the maximum strength show, the difference between the obtained data is significant.

Table 1: the effect of different amounts of soy flour on the cake texture properties of different cakes

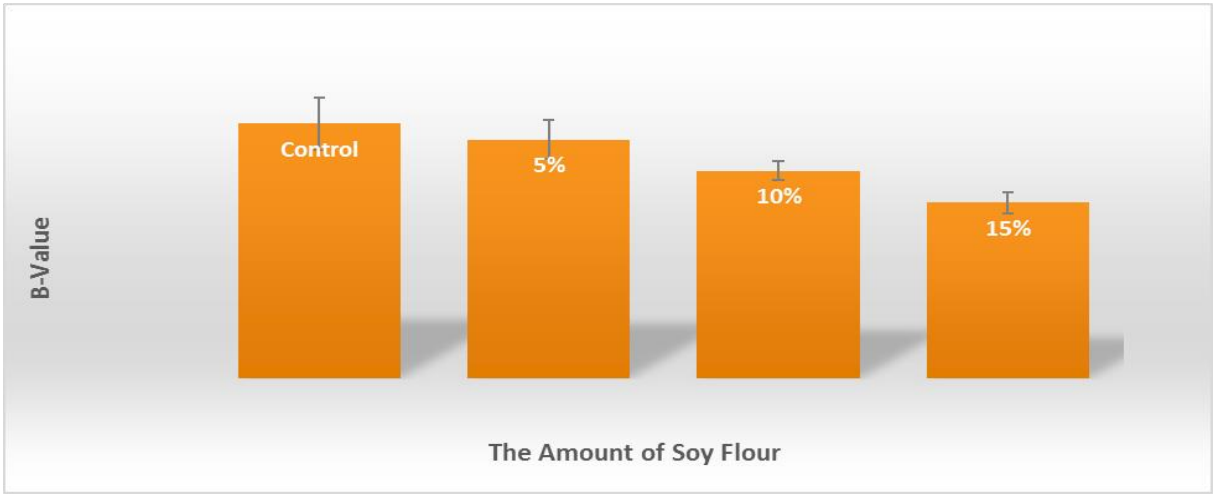
Soy amount	Strength (N)	Slope (N/S)	Cohesiveness	Springiness
Control	2.214±0.0146 [d]	0.447± 0.005 [d]	0.807± 003 [a]	0.989±0.002 [a]
5%	2.704± 0.0090 [c]	0.492±0.200 [c]	0.792± 0.002 [b]	0.987± 0.002 [a]
10%	2. 801± 0.003 [b]	0.523± 0.004 [b]	0.761± 0.007 [c]	0.964± 0.003 [b]
15%	2.893± 004 [a]	0.542± 0.001 [a]	0.752± 0.004 [d]	0.959± 0.003 [b]

Different lower case letters show significant difference in each row (p≤%5) and Average scores of five replications have been reported as average ± standard deviation.



Graph 1: Comparison of the increase in the soy flour amount on the texture lightness (L-value) of the cake samples

Graph 2: The comparison of the effect of the soy flour increase on the A-value of the cake samples



Graph 3: The comparison of the effect of the increase in the soy flour amount on the B-value of the cake samples

On the other hand, examining the slope of the created graphs during the compression test showed that the slope of different samples representing hardness of the cake samples increased as the amount of the soy flour increased. So that minimum slope (N/S) was 0.447 related to the control sample and the maximum slope (N/S) was 0.542 related to the sample enriched with %15 soy flour. It should be pointed out that statistical differences between the calculated slopes in different cake samples were completely significant, and there was a positive relationship between the soy flour amount and the slope value.

The histological parameters of the texture cohesiveness of the samples of the sponge cakes based on table 1 show that as the soy flour amount increased in the samples, their cohesiveness decreased. So, the control samples with %15 soy flour show the minimum amount of cohesiveness. Data analysis obtained from the cohesiveness test show that the samples were significantly different from each other in terms of their cohesiveness.

Analysis of the springiness factor in different cake samples which represent the recovery of the cake after the compression indicates that as the soy flour amount increased, the springiness of the samples with 15% soy flour showed the maximum springiness and recovery after the compression and there was no significant difference between the two samples. As the soy flour amount increased, the springiness decreased.

So, the cakes with 10 and 15% soy flour indicated the minimum amount of springiness and recovery after the compression although no significant difference was observed between the two samples.

The results of table 1 show that with an increase in the soy flour ratio, the maximum strength also increased. Maximum strength is a measure of the hardness of the cake. The measured slope also increased in all cases which was the result of the higher soy protein content. On the other hand, it is clear that as the texture hardness increased, the resilience and the springiness of the prepared cakes decreased. After removing the probe device in the density test, the cake samples rarely turned into their original form (recovered). It means that as the soy flour content increased, the springiness decreased and also the cohesion between the matrix and the network created inside the cake decreased as the toy flour content increased.

The Colorimetric Test

The obtained results of the effect of the different levels of the soy flour on the colorimetric properties of the sponge cake were demonstrated in Graphs (1-3). The greater amount of the replaced wheat flour was correspondent with the less lightness or L-value (Graph 1). It means that as the soy flour amount reached to %15, the lightness decreased and the sample became darker.

Investigating A-value (redness-greenness) in different samples shows that as the amount of the soy flour increased, A-value increased too. It means that the texture color becomes red. Increasing in the redness is attributed to the increase in Millard reactions took place in the process of baking the cake. The higher amount of soy flour and the protein content is correspondent to the increase in the reactions (graph 2).

The effects of the different amounts of the soy flour on the B-value (blueness-yellowness) were demonstrated in (Graphs 3).

As it is observed the higher amount of the soy flour is correspondent to the decrease in the B-value. This means that as the soy flour amount reached from %5 to %15, the B-value decreased. This is not significant between the control samples and the samples with 5% of the soy flour. Decrease in the B-value was correspondent to the texture yellowness.

Discussion

The Texture

Indeed, the increasing protein level prevents the increase in the product volume due to the disruption of the starch matrix. As the volume decreased, the density increased and in turn the texture hardness increased.

In order to study the results of used soy flour to enrich extruded products showed that when the soy flour was added to the central-based products, the interaction between protein and starch reduced the amylopectin chain expansion which in turn prevented the water vapor releasing during the process of baking cakes. So density and hardness of the final product increased (Seker, 2005).

In else research there was a gradual decrease in hardness of cakes supplemented with r-soy flour indicating softness in the texture of cakes. Thus the quantity and quality of protein contents and texture of cakes was improved with the addition of soy flour (Ahmad *et al.,* 2010)

The Colorimetric Test

The color of the biscuits with soy flour is significantly darker. The lightness decreases due to the high amount of the protein content of the soy flour in these products so the Millard reaction takes place between the amino acids and the reducing sugar. These reactions increases while the protein content of soy flour increases and the color of the cake become darker (Siddiqui *et al.,* 2003).

Statistical analysis have shown that fortification of bread with different levels of soy flour will led to a significant effect on mean L, mean a, mean b, standard deviation of L and b (Ehteiati *et al.,* 2008).

The results of else research indicate that as the quantity of the soy flour increased, the color of the cake samples became darker. The higher substitution of the soy flour for the wheat flour in the sponge cake made the cake darker (Ahmad *et al.,* 2010). These results are in line with the results of this study

Conclusion

Tissue tests revealed that by increasing the use of soy flour and increase the amount of protein in the final product represents the maximum power and the firmness of the slope that rises, But the value of continuity and flexibility will be reduced. The results of colorimetric tests also showed that by increasing the amount of soy flour and increase the amount of protein due to the intensification of the Maillard reaction of the L-value decreases the brightness also, by increasing the amount of soy flour a-value increase, but the b-value decreases.

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